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| APPLICATION NO.  | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO.         | CONFIRMATION NO. |
|--|-------------|----------------------|-----------------------------|------------------|
| 10/823,088   | 04/12/2004  | Ning Wang            | 318-000220US                | 3167             |
| 22798 7590 12/28/2006<br>QUINE INTELLECTUAL PROPERTY LAW GROUP, P.C.<br>P O BOX 458<br>ALAMEDA, CA 94501 |             |                      | EXAMINER<br>CANTELMO, GREGG |                  |
|  |             |                      | ART UNIT<br>1745            | PAPER NUMBER     |
| SHORTENED STATUTORY PERIOD OF RESPONSE   |             | MAIL DATE            | DELIVERY MODE               |                  |
| 3 MONTHS   |             | 12/28/2006           | PAPER                       |                  |

**Please find below and/or attached an Office communication concerning this application or proceeding.**

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

# Office Action Summary

Application No.

10/823,088

Applicant(s)

WANG ET AL.

Examiner

Gregg Cantelmo

Art Unit

1745

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 03 October 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 87-92 and 94-112 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 87-92, 94-108 and 112 is/are rejected.
- 7) ☒ Claim(s) 109-111 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 03 October 2006 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

## Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

## Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_
- ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_
- ☐ Notice of Informal Patent Application
- ☐ Other: \_\_\_\_\_

## **DETAILED ACTION**

### ***Response to Amendment***

1. In response to the amendment received October 3, 2006:
  - a. Claims 87-92 and 94-112 are pending;
  - b. The objection to priority stands;
  - c. The objection to the specification stands;
  - d. The remaining previous objections and rejections have been withdrawn in light of the amendment and applicant's arguments. However it is noted that Yan does in fact qualify as prior art since it has an earlier *effective filing date*.  
  
Applicant is advised that it is not the publication date but rather the filing date of the given publication which establishes the earliest effective filing date of the Yan reference. Review of these dates should clearly establish that Yan does qualify as prior art.

### ***Priority***

2. Applicants claim to U.S. provisional application serial No. 60/501,158, filed September 8, 2003 and U.S. provisional application serial No. 60/549,712, filed March 2, 2004 are acknowledged. It is noted however that priority has not been granted for the claimed method. Each provisional application, while detailing the catalytic material of Pt-V-"M" does not provide reasonable support for the claimed method. For example, neither provisional application provides any disclosure with respect to the nanoparticle catalysts as claimed (notably the catalyst materials of claim 94 which is the catalyst for forming the carbon nanotubes).

***Response to Arguments***

3. Applicant's arguments filed October 3, 2006 have been fully considered but they are not persuasive. While the claim to priority to the broadest claims seems appropriate, the Examiner maintains that the priority benefit does not extend to all of the claims as set forth above and in the previous office action.

***Specification***

4. The final paragraph of the specification incorporates by reference, all publications, patents and patent applications cited in the specification. However the incorporation of essential material in the specification by reference to an unpublished U.S. application, foreign application or patent, or to a publication is improper. Applicant is required to amend the disclosure to include the material incorporated by reference, if the material is relied upon to overcome any objection, rejection, or other requirement imposed by the Office. The amendment must be accompanied by a statement executed by the applicant, or a practitioner representing the applicant, stating that the material being inserted is the material previously incorporated by reference and that the amendment contains no new matter. 37 CFR 1.57(f).

5. The disclosure is objected to because of the following informalities: The specification recites that  $\text{Co}_{1-x}\text{Mo}_x$  wherein  $0 \leq x \leq 0.3$ . However the specification then defines a specific Co-Mo alloy with subscript values which are  $\text{Co}_{0.88}\text{Mo}_{1.2}$ . The values in are inconsistent with the range of  $0 \leq x \leq 0.3$ . It may be that  $\text{Co}_{0.88}\text{Mo}_{1.2}$  should be  $\text{Co}_{0.88}\text{Mo}_{0.12}$  to agree with the subscript ranges. Furthermore if Applicant adopts this change, the changes should also be applied throughout the specification for each

instant where this issue similarly arises for other catalyst species. Appropriate correction is required.

### ***Response to Arguments***

6. Applicant's arguments filed October 3, 2006 have been fully considered but they are not persuasive.

As to item 4 above, Applicant's response fails to address this objection. Thus there is no basis for withdrawing this objection and the objection stands.

As to item 5 above, Applicant fails to provide sufficient arguments to overcome the objection to the inconsistencies in the subscripts of the various Co/Mo compositions disclosed. Therefore the objection stands.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

7. Claims 87, 91-94, 98-99 and 104-107 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent Application Publication No. 2004/0167014 (Yan) in view of U.S. Patent No. 4,447,506 (Luczak) and either U.S. Patent No. 6,984,579 (Nguyen) and or U.S. Patent Application Publication No. 2003/0124717 (Awano).

Yan, having an earlier effective filing date compared to the instant application, still qualifies as prior art, contrary to Applicant's assertion.

Yan discloses a method of preparing a fuel cell element comprising: providing a carbon porous electrode substrate, depositing a nanoparticle catalyst on the electrode (20-50 nm in paragraph [0038]), forming nanoparticles on the porous electrode using the nanoparticle catalyst and forming a catalytically active layer on the nanoparticles to form a fuel cell element comprising fibers bearing nanoparticles partially or fully coated with a catalytically active film (paragraphs [0037]-[0039]). The nanoparticles are carbon nanotubes (paragraph [0037] -[0039]), the fiber is a porous carbon paper (paragraphs

Art Unit: 1745

[0037]-[0039]), the catalyst for forming the nanotubes is cobalt and the electrode catalyst is platinum (paragraphs [0037]-[0039] as applied to claim 87).

The nanoparticle cobalt catalyst forms carbon nanotubes (as applied to claim 91).

The method of forming the nanoparticles includes CVD (abstract as applied to claim 92).

The catalyst includes cobalt (prior art claim 3). Note that the range for Mo in the  $\text{Co}_{1-x}\text{Mo}_x$  alloy includes 0 and therefore the elected catalyst species can be cobalt itself, as taught by Yan (as applied to claim 94).

The platinum film is a "substantially continuous" film that at least partially covers the nanoparticles. Note the term "substantially continuous" fails to define the extent to which the claimed film is construed to be continuous (as applied to claims 98 and 99).

The electrode catalyst is platinum.

The differences between the claimed invention and Yan, with respect to the elected species, are that Yan does not teach of using a platinum alloy catalyst (claims 87, 104-107) or of using CVD to deposit the Co or Co/Mo catalyst (claim 87).

As to forming the Co or Co/Mo catalyst by CVD:

It appears that Yan forms the cobalt catalyst layer by electrodeposition (see paragraph 38).

While Yan does not teach of forming the cobalt catalyst by CVD, the use of any number of deposition techniques such as CVD, PVD, MBE, laser ablation,

Art Unit: 1745

electrodeposition would have been obvious variants over one another for the same benefit of forming the cobalt or cobalt/molybdenum layer on the base. In each process the same resultant catalytic layer would be provided for forming the carbon nanoparticles.

A review of the specification further fails to show clear and unexpected advantages of CVD compared to other known deposition techniques and thus the selection of any conventional deposition technique is held to be an obvious modification of Yan.

In addition, it is known to deposit seed catalyst layers such as Co in carbon nanotube fabrication processes as shown by Nguyen (col. 2, ll. 55-65) and Awano (paragraph 17).

Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the teachings of Yan by using any known conventional deposition technique to form the catalyst or seed layer prior to forming the nanotubes since they would have provided equivalent means for forming the catalyst layer. Furthermore since the nanotubes of Yan are formed by CVD, it would have also been obvious to use CVD for the other deposition processes including the fabrication of the catalyst particles since it would have reduced the complexity and cost of the process by reducing the number of distinct deposition systems to fabricate the multilayer product of Yan.

As to the platinum alloy catalyst:



The use of platinum-vanadium-cobalt alloys as a catalyst material in fuel cell electrodes has been established in the art as shown by Luczak (Example 2, column 4).

The motivation for using the platinum-vanadium-cobalt catalyst of Luczak is that it has a better activity at a lower cost relative to pure platinum.

Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the teachings of Yan by using the platinum-vanadium-cobalt catalyst of Luczak since it would have provided a catalyst material which exhibited a better activity at a lower cost relative to pure platinum. The selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945) See also *In re Leshin*, 227 F.2d 197, 125 USPQ 416 (CCPA 1960). MPEP § 2144.07.

With respect to the amount of platinum present in the alloy as recited in claims 106 and 107.

Again, one of ordinary skill in the art would have had known the high cost of platinum metal as an adverse manufacturing cost for developing catalytic materials for fuel cell electrodes. Thus the motivation for reducing the amount of platinum in a fuel cell catalyst was to reduce the cost of production of the fuel cell without compromising the catalytic activity of the catalyst material.

Therefore it would have been obvious to one of ordinary skill in the art to reduce the amount of platinum in the alloy as low as possible to lower the cost of the catalyst material without compromising the catalytic activity of the catalyst itself.

Art Unit: 1745

8. Claim 95 is rejected under 35 U.S.C. 103(a) as being unpatentable over Yan in view of Luczak and either Nguyen or Awano as applied to claim 94 above, and further in view of either U.S. Patent No. 5,997,832 (Lieber) or U.S. Patent No. 6,333,016 (Resasco).

The difference not discussed is of the catalyst being a  $\text{Co}_{0.8}\text{Mo}_{1.2}$  alloy.

It is well known in the art to use various combinations of metal catalyst materials to grow carbon nanotubes including Co-Mo alloys (see col. 5, ll. 19-27 of Lieber and col. 4, ll. 52-65 of Resasco).

While Applicant has selected a particular species of  $\text{Co}_{0.8}\text{Mo}_{1.2}$  wherein  $0 \leq x \leq 0.3$ , it is apparent that any number of catalyst materials can be used to obtain the same desired nanotubes.

Thus the selection of the claimed cobalt-molybdenum catalyst material would have been obvious to one of ordinary skill in the art as a suitable catalytic material for producing carbon nanotubes.

9. Claims 96 and 97 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yan in view of Luczak and either Nguyen or Awano as applied to claim 91 above, and further in view of U.S. Patent No. 6,949,308 (Gascoyne).

The differences not discussed are of the particularly claimed dimensions of the nanotubes (claims 96 and 97).

The diameter of the nanofibres can typically be adjusted from 10 nanometres to 500 nanometres and their length from 1 micron to 100 microns. Typical aspect ratios range from 5 to as high as 1000. In the present invention, the nanofibres used suitably

Art Unit: 1745

have a length less than 100 microns, preferably less than 50 microns. The diameter of the nanofibres is suitably less than 500 nm, preferably less than 200 nm, more preferably less than 100 nm (col. 4, ll. 15-24).

It is apparent that the particularly claimed dimensions are known in the art and thus readily apparent to one of ordinary skill in the art as suitable dimensions for the nanotubes employed in fuel cell electrodes. Generally, differences in ranges will not support the patentability of subject matter encompassed by the prior art unless there is evidence indicating such ranges is critical. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980). In re Aller, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955). In re Hoeschele, 406 F.2d 1403, 160 USPQ 809 (CCPA 1969).

10. Claims 99-103 and 112 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yan in view of Luczak and either Nguyen or Awano as applied to claim 98 above, and further in view of U.S. Patent No. 4,395,322 (Harris).

As discussed above, Yan discloses providing a carbon fiber porous electrode substrate upon which nanoparticle size Co catalyst material is deposited by CVD so as to form carbon nanotubes on the substrate. Thereafter a platinum catalyst material is provided on the carbon nanotubes via CVD to form the fuel cell electrode (as applied to claim 112).

The differences not discussed are of the film fully coating the nanoparticles with the catalyst material (claims 99 and 112) and of the claimed thickness of the catalyst film (claims 100-103).

With respect to providing either a discontinuous or full film coating (claims 99 and 112):

According to Harris, the deposited metal can be deposited in a number of forms. It can be discontinuous such as, for example, in the form of discrete islands, or it can be continuous such as in the form of an interconnected network, for example, a continuous film with pinholes therein. It also can be a totally continuous film, i.e. a solid film or coating with no discontinuities or pinholes therein (col. 3, ll. 46-64).

Harris therefore teaches that it is known in the art to provide a number of different catalyst layer configurations. In addition the instant application fails to show criticality between partial or full coatings.

In selecting the nature of the coating, one of ordinary skill in the art would have recognized that providing a full coating, while increasing the cost of production would have provided a greater catalytic reaction site across the electrode thereby optimizing and maximizing the catalytic property of the electrode.

With respect to the thickness of the catalyst layer (claims 100-103):

Harris further teaches that usually, thinner deposits of catalytic metal are in the form of discrete islands, and as the thickness of the deposited metal increases, it becomes an interconnected network, and finally with still increasing deposition thickness, i.e. a thickness of the order of about 20 Angstroms to about 25 Angstroms, it becomes a totally solid continuous film, i.e. a film or coating with no pinholes or discontinuities therein. Once a continuous totally solid film or coating is deposited on the conductor, additional deposition of catalytic metal does not improve the catalytic activity of the electrode but it is likely to improve its lifetime (col. 3, ll. 46-64).

Art Unit: 1745

One of ordinary skill in the art would have recognized that reduced film thickness for the platinum alloy catalyst would have been preferred so long as it provides suitable catalytic properties for the further benefit of reducing the production cost of the fuel cell by limiting the amount of noble metal catalyst in the fuel cell.

Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the teachings of Yan by selecting the thickness of the catalyst layer to be about 20-25 angstroms as taught by Harris since it would have provided a functional catalyst layer for the electrode at a lower cost of production. Generally, differences in ranges will not support the patentability of subject matter encompassed by the prior art unless there is evidence indicating such ranges is critical. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980). In re Aller, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955). In re Hoeschele, 406 F.2d 1403, 160 USPQ 809 (CCPA 1969).

### ***Response to Arguments***

11. Applicant's arguments have been considered but are moot in view of the new ground(s) of rejection.

### ***Allowable Subject Matter***

12. Claims 109-111 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter: none of the prior art of record appears to teach, fairly suggest or render obvious

Art Unit: 1745

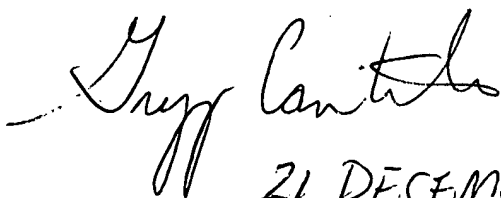
the invention of claim 109. In particular: While Luczak discloses that ternary Pt-V-Co catalyst materials are known in the fuel cell art, neither Luczak nor the remaining prior art of record appears to teach, suggest or render obvious the quaternary catalyst material of claim 109.

### **Conclusion**

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Gregg Cantelmo whose telephone number is 571-272-1283. The examiner can normally be reached on Monday to Thursday, 8:00-5:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Pat Ryan can be reached on 571-272-1292. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.



Gregg Cantelmo  
Primary Examiner  
Art Unit 1745

21 DECEMBER 2006

Application/Control Number: 10/823,088

Page 14

Art Unit: 1745

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December 21, 2006